Zootaxa 1495: 35–45 (2007)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

A new thrips pest of *Myoporum* cultivars in California, in a new genus of leaf-galling Australian Phlaeothripidae (Thysanoptera)

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Abstract

A new genus of Australian Phlaeothripidae is described, *Klambothrips*, to include a new species of gall-inducing thrips, *K. myopori*, that is a pest on the leaves of prostrate and upright *Myoporum* shrubs in California. A closely related thrips, *Liothrips walsinghami* Girault, is also included in this genus. This thrips is common in the coastal regions of south eastern Australia damaging the leaves of *Myoporum insulare*. Two further Australian thrips species are also placed in *Klambothrips*, both inducing leaf distortions on plants in the Asteraceae: *Rhynchothrips annulosus* Priesner on *Cassinia*, and *Klambothrips oleariae* **sp. n.** on *Olearia*. These thrips are all members of the "*Teuchothrips* complex", and molecular data is presented indicating that the members of this complex constitute a series of separate lineages, one of which comprises the four species of *Klambothrips*.

Key words: *Klambothrips myopori*, new genus and species, *Teuchothrips*, gall thrips

Introduction

In California U.S.A., a species of tubuliferan thrips has recently become a serious pest on a common urban ornamental shrub, *Myoporum*, inducing considerable leaf deformation through its feeding activities (Fig. 1). Entomologists in the USA considered that this pest thrips was not native to that country, and the possibility was raised that it might have been accidentally introduced from Australia. The plant family Myoporaceae comprises two major genera, *Eremophila* in which all 180 species are from Australia, and *Myoporum* in which most of the 32 species are Australian although with a few occurring in the area between Mauritius and New Zealand. Unfortunately, this new pest in California belongs to a group that is poorly studied, in which species and genera are equally ill-defined, this group being referred to as the "*Teuchothrips*-complex". In describing this pest as a new species, an assessment is made of its relationships to similar thrips from Australia, and a new genus is proposed for four species that produce similar-looking irregular gall-like leaf distortions on different species of plants. This paper is part of continuing studies on the biology and taxonomy of an extensive Australian radiation of leaf-galling thrips on many different native plant species.

Host plant and damage

In California, leaf distortion by the *Myoporum* thrips described below has been reported from five counties, San Diego, Santa Barbara, Orange, Los Angeles and Ventura. There is an expectation in the horticultural trade that this thrips will spread rapidly to wherever the host is planted causing spectacular and unsightly damage. In particular, species of *Myoporum* are planted along 1000's of kms of residential and freeway road margins. Consequently, continued planting and traffic movement can be expected to facilitate the continued

Accepted by Z. Zhang: 1 May 2007; published: 31 May 2007

widespread distribution of this thrips. The drought hardiness of *Myoporum*, and the fact that the plants are generally so pest free, has made members of this genus suitable for decorative planting in much of southern California. The hardiness of *Myoporum* is now leading to the plants being considered invasive weeds in some areas of California, presumably through seed dispersal by birds. Paradoxically, if the weed status of *Myoporum* increases in California, then this new pest thrips may actually come to be regarded as beneficial, because it will have value as a biological control agent. The plant species on which thrips damage is particularly reported is *Myoporum laetum*, a plant originally from New Zealand. However, new varieties are being developed by the horticultural trade, including a susceptible prostrate form, "Myoporum Pacificum". Also being marketed in California, according to various websites, are two Australian species, *M. debile* and *M. parvifolium*, and the most common Australian species, *M. insulare*, has been reported to be a useful fire resistant shrub in coastal California.

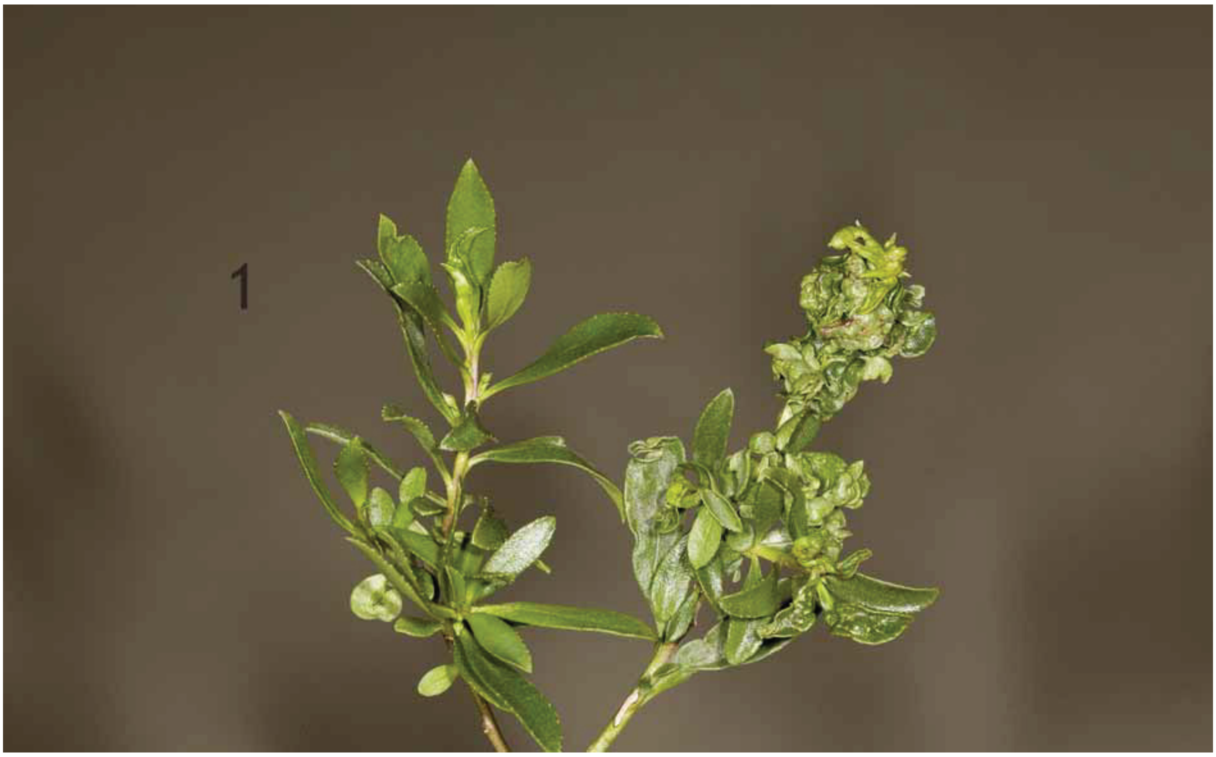


FIGURE 1. Healthy and thrips-damaged *Myoporum laetum* in California.

From New Zealand there are no reports of thrips damage to the leaves of *M. laetum*. However, in southern Australia, *M. insulare* commonly supports considerable populations of a thrips that is structurally very similar to the Californian pest. The resultant distorted leaves, or ill-formed galls, have been collected widely around the south eastern coast of Australia, between Adelaide and the Victoria/New South Wales border. *M. insulare* has a natural distribution along the coast from at least the Nullarbor in the West to south of Sydney on the east coast, and including northern Tasmania. However, *M. insulare* has also been planted in southern Australia outside its natural range. Because of its drought resistant abilities as a fast-growing and hardy wind break, the species was planted widely by soldier settlers in the western districts of Victoria during the 1940's and 1950's, and similarly in the Murray River area of South Australia. Leaf distortion by thrips has been observed on *M. insulare* throughout these areas.

Thysanoptera Phlaeothripidae as pests

The thrips that is damaging *Myoporum* is a member of the Phlaeothripidae, one of the two major families of Thysanoptera. In general, pest thrips belong to the second major family, the Thripidae (Mound, 2005a),

including all of the known tospovirus vectors (Mound, 1996b). In contrast, many species of Phlaeothripidae are fungus-feeders, on dead twigs, dead leaves and in leaf litter (Morse & Hoddle, 2006), with flower-feeding occurring among a smaller group of species, mostly Holarctic members of the genus *Haplothrips* (Mound & Minaei, in press). A few phlaeothripids are predatory, but the species of the other major group in this family feed on green leaves, some inducing galls (Mound, 1994). These leaf-feeding Phlaeothripidae are often host-specific (Mound, 2005a), thus greatly limiting their potential to be general crop pests.

One pest phlaeothripid, the Cuban laurel thrips, *Gynaikothrips ficorum* (Marchal), is well known around the world inducing leaf-galls on cultivated *Ficus microcarpa* (Mound *et al.*, 1996; Boyd & Held, 2006). In south eastern Asia, *Piper* species, both wild and cultivated, often exhibit leaf-curl damage due to *Liothrips piperinus* Priesner and related species (Ananthakrishnan & Raman, 1989). Similarly, *Liothrips vaneeckei* Priesner is widespread as a minor pest on lily bulbs (Malipatil *et al.*, 2002), and *Liothrips adisi* zur Strassen damages the leaves of *Paullinia cupana*, the Brazilian tree from which the drink Guarana is produced (zur Strassen, 1978). In Japan, the cruciferous spice plant, *Wasabia japonica*, is damaged by *Liothrips wasabiae* Haga & Okajima, and the leaves of persimmon (*Diospyros kaki*) are galled by *Ponticulothrips diospyrosi* Haga & Okajima (Okajima, 2006). With so few pest species recorded amongst the Phlaeothripidae, the societal impact of this widespread family of thrips is limited, despite the large numbers of species and their intrinsically interesting biologies, including sub-sociality (Crespi, 1990), eusociality (Crespi *et al.*, 2004), and striking structural polymorphisms (Mound, 2005b).

Thysanoptera Phlaeothripidae classification

The Phlaeothripidae is the sole family recognized by most entomologists in the sub-order Tubulifera, despite a large number of family-group names having been proposed (see, Mound & Morris, 2004). Of the 3400 described species in this family, most are placed in the subfamily Phlaeothripinae, with about 700 that apparently feed on fungal spores being referred to the subfamily Idolothripinae. Evolutionary relationships within, and classification of, the Phlaeothripinae remains unclear, with three ill-defined lineages being recognized, each centred around one major genus (Mound & Marullo, 1996). The small "*Haplothrips*-lineage", in which many species are flower-feeders, has recently been formally defined and recognized at the tribal level as the Haplothripini to include about 35 genera (Mound & Minaei, in press). The much larger "*Phlaeothrips*-lineage" is more difficult to define, particularly because of the structural polymorphisms that occur in the large number of fungus-feeding species involved (Mound, 2005b). Similarly large and problematical is the "*Liothrips*-lineage" of leaf-feeding species, and it is within this group of more than 150, often poorly defined, genera that the new pest species is placed, together with all the pest Phlaeothripidae noted above.

The *Liothrips*-lineage of Phlaeothripinae

Within the *Liothrips*-lineage the main genus, *Liothrips* Uzel, is the largest genus of Thysanoptera, with 290 species currently listed worldwide (Mound 2007). However, the genus is not clearly defined from other genera, and only five species are listed from Australia. A related genus, *Teuchothrips* Hood, includes 30 species, of which 21 are from Australia, five from New Caledonia, three from Indonesia, and one from India. This genus is not clearly defined from *Liothrips*, and many of the described species in these two genera are known from very few specimens, with little information on host relationships or intraspecific structural variation. Recent examination of the original material of the 21 Australian species listed in *Teuchothrips* has indicated that they cannot all be considered con-generic. Moreover, field work across Australia in the past 10 years has produced many similar-looking species in this "*Teuchothrips*-complex", often associated with leaf deformation on particular species of native Australian plants.

Formal taxonomic work on these leaf-feeding Australian thrips is dependent on further field studies, partly to establish host associations more firmly, but also to rediscover several of the un-recognisable species that were described briefly by Girault during the 1920's and 1930's (Gordh *et al.*, 1979). A further related

genus is *Akainothrips* Mound from Australia. This genus involves 33 species, all of which are associated only with the phyllodes of *Acacia* species (Crespi *et al.*, 2004), although none is known to induce distortion on these plants. The leaf-damaging *Myoporum* thrips is here considered to be related to *Akainothrips*, but because of biological, structural and molecular differences it is described within a new genus, together with three other Australian species of which two are currently listed under *Teuchothrips*. One of these three species is common in galled leaves of *Myoporum insulare* around south eastern Australia, but the other two are associated with leaf distortion on Asteraceae shrubs: one on the genus *Ozothamnus* (or *Cassinia*) in Australia and New Zealand, and the other on *Olearia lirata* in south eastern Australia.

Molecular data

Thysanoptera species are identified and classified according to their morphological characteristics, but molecular data is increasingly being included in taxonomic investigations (Morris & Mound, 2003; Crespi *et al.*, 2004; McLeish *et al.*, 2006; Rugman-Jones *et al.*, 2006). Because of this increasingly important trend in thrips identification and systematics, DNA was extracted from a range of Australian Phlaeothripidae species that are associated with, or induce galls on, various Australian plants. The thrips specimens were collected into 95% ethanol and stored at -20° prior to DNA extraction with an EDNA HiSpEx tissue kit (Fisher Biotech Australia) using the manufacturers' protocol. DNA was extracted from individual thrips specimens, the cuticles of which were recovered during the extraction protocol and then slide mounted for identification purposes. The DNA regions of interest were amplified with PCR using a standard 30 sec at 94°, 30 sec at 45°, 30 sec at 72° protocol for 35 cycles preceded by 1 cycle of 94° for 4 mins and ending with a cycle of 5 mins at 72°. The regions amplified were from mitochondrial COI with primers LepF1 and LepR1 (Hebert *et al.*, 2004), and nuclear *wingless* using the primers lepwg1 and modlepwg2 (Brower and DeSalle 1998). Products resulting from PCR were purified using ExoSapIT (Invitrogen Australia) and sequenced on an ABI 3100 sequencer using the ABI Big-dye Ready Reaction kit (Applied Biosystems).

The resulting DNA sequences were edited using Sequencher 4.5 (Gene Codes, USA), aligned manually and analysed in PAUP* (Swofford 2003). Each region was analysed separately using parsimony (trees not shown) and an Incongruence Length Difference (ILD) was performed to test for combinability of the two regions (P =0.18). The two regions were then analysed together using maximum parsimony (MP) and maximum likelihood (ML) methods. The model used for the ML analyses was a general time reversible with gamma and invariant sites parameters (GTR +I + Γ). Two trees resulted from the MP analysis, one of which showed the same topology as the single tree given by the ML analysis, the other tree differed only in the placement of *Akainothrips juliae*. The results of the combined ML analysis are shown in Fig 5. The terminals indicated are all based on single individuals, with the exception of the three *Klambothrips* for which two individuals were sequenced (for *K. myopori*, two individuals from each of two different counties in California). All of the duplicate sequences were identical to each other, and therefore are represented by single terminals.

This work in no way represents a complete phylogenetic analysis of the relationships between these gall thrips, but is presented here to emphasise the complexities involved in assessing relationships between organisms such as these thrips species that are structurally homogeneous, homoplastic and also polymorphic. Figure 5 indicates that the *Acacia* gall-inducing thrips, the species of *Kladothrips*, and also their kleptoparasites, form clades that are distinct from the gall thrips of the *Teuchothrips* complex. Moreover, the various species that are currently placed in *Teuchothrips* apparently represent a series of relatively unrelated clades – as suggested in the paragraph above based on morphological data. Unfortunately, the host association of the type species of this genus, *Teuchothrips simplicipennis* Hood, is not yet known, and fresh material is not available. Based on morphological character states it seems likely to be related to *T. minor* (Fig. 5), as both species lack duplicated cilia on the forewings. The two most frequently encountered species of this complex, inducing leaf distortion on common garden shrubs, *T. pittosporiicola* Bagnall on *Pittosporum undulatum* and *T. disjunctus* (Hood) on *Callistemon citrinum*, will probably need a new generic assignment, and the two species indicated

as "Teucho Drypetes" and "Teucho Leptospermum" (Fig. 5) are also considered to require new genera on morphological grounds. The clade that concerns the present study is in the centre of Figure 5, and brings together species that are here treated as members of the new genus.

Klambothrips gen. n.

Type species *Klambothrips myopori* **sp. n.**

In most character states, including the presence on the head of a pair of stout cheek setae, the four species placed in this new genus are similar to some of the 33 species currently placed in the genus *Akainothrips* Mound, all of which live on *Acacia* trees (Crespi *et al.*, 2004). However, these four species all have the mid and hind tibiae uniformly dark brown whereas similar looking *Akainothrips* species that lack pronotal antero-marginal setae have the tibiae yellow at the apex. Moreover, the four species of *Klambothrips* are all associated with the leaves of species of Myoporaceae or Asteraceae, on which they induce the irregular galls from which the generic name is derived (Fig. 1). In contrast, all *Akainothrips* species are opportunistic invaders of pre-existing enclosed spaces on species of *Acacia* that bear phyllodes not leaves (Crespi *et al.*, 2004). The species of *Akainothrips* and *Klambothrips* differ from all of the Australian species currently listed under *Teuchothrips* in the presence of a pair of stout cheek setae. As indicated above, the generic classification of the species currently listed under *Teuchothrips* remains unsatisfactory. But the available evidence, biological, morphological, and molecular (Fig. 5), indicates that the four species considered here are sufficiently closely related to be considered congeneric and distinct from the other members of this complex of species.

Generic diagnosis. Dark brown, macropterous Phlaeothripinae. Antennae 8-segmented, III with one sensorium, IV with three sensoria, VIII broad at base. Head longer than wide; cheeks with one pair of stout setae in basal third; maxillary stylets retracted at least to postocular setae; postocular setae no larger than minor setae. Pronotum with three pairs of capitate major setae, anteromarginals and midlaterals usually no larger than discals. Prosternal basantra not developed; anterior margin of ferna almost transverse; mesopraesternum reduced to two small lateral triangles. Fore tarsus with inner apex slightly recurved forming a small tooth. Metanotum reticulate, with one pair of setae medially; sternopleural sutures elongate. Forewing parallel sided, with six to nine duplicated cilia; with one or two capitate sub-basal setae. Pelta triangular, reticulate, with paired campaniform sensilla; tergites II – VII with two pairs of sigmoid wing-retaining setae, marginal setae S1 capitate and longer than setae S2; tergite IX setae S1 and S2 shorter than tube, bluntly pointed to weakly capitate, S3 acute; anal setae long. Males varying in size; large males with fore tarsal tooth massive and femora swollen, and fore coxae bearing stout setae; tergite IX setae S2 capitate but shorter than S1; sternite VIII without glandular area.

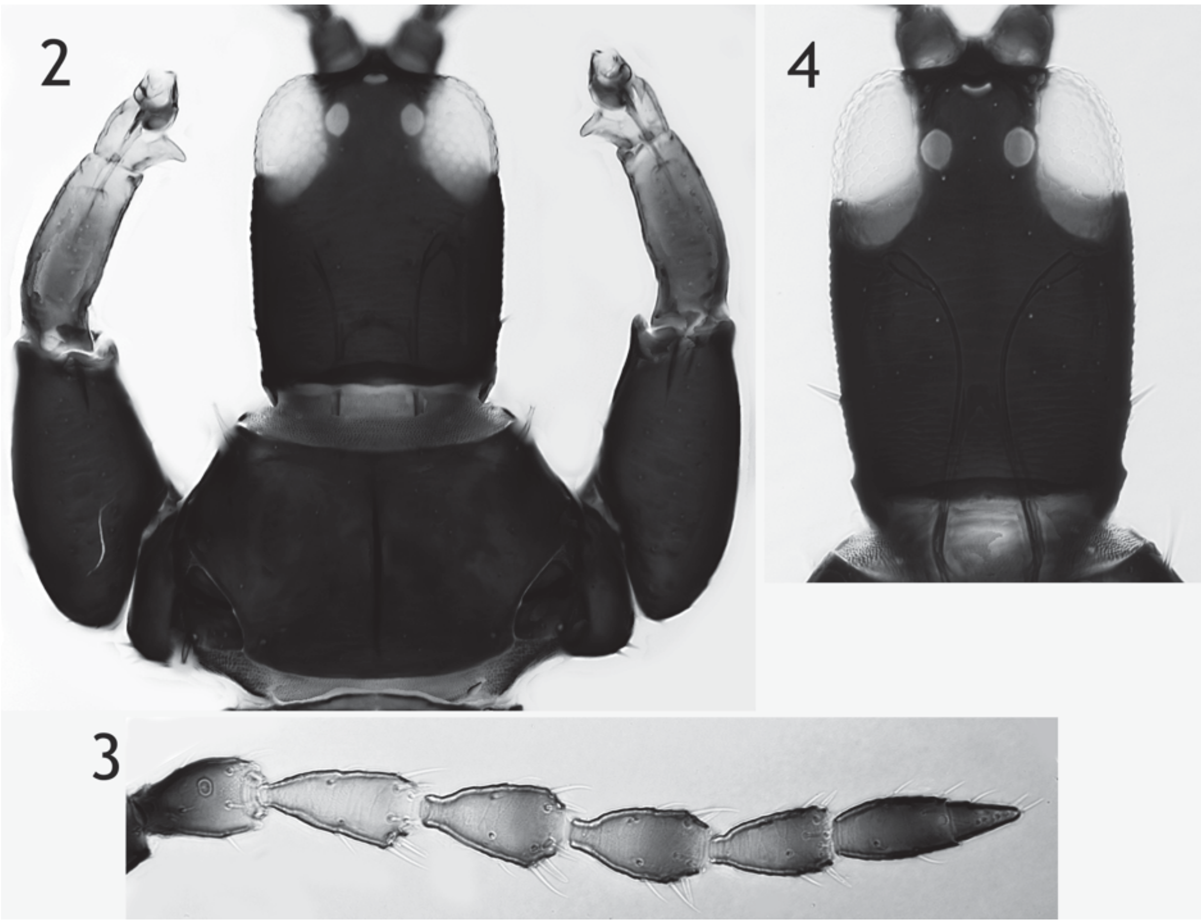
Key to *Klambothrips* species

1. Hind tarsi yellow to brownish yellow, clearly paler than tibiae; tergite IX setae S1 with apices capitate . 2
-. Hind tarsi brown, scarcely paler than tibial apex; tergite IX setae S1 bluntly pointed to broadly rounded 3
2. Maxillary stylets about 0.3 of head width apart, retracted into head only to level of postocular setae (Fig. 2) .... *myopori* **sp. n.**
-. Maxillary stylets scarcely 0.1 of head width apart, retracted to eyes (Fig. 4) .... *walsinghami* (Girault)
3. Maxillary stylets retracted to eyes, close together medially in head; tergite IX setae S1 and S2 bluntly pointed; longest anal setae longer than tube .... *annulosus* (Priesner)
-. Maxillary stylets retracted to postocular setae, about one fifth of head width apart; tergite IX setae S1 and S2 broadly rounded; anal setae shorter than tube .... *oleariae* **sp. n.**

Klambothrips myopori sp. n.

Macropterous female. Body brown to dark brown, tarsi yellow; antennal segment III yellow with faint shading distally (Fig. 3), IV – VI yellow with apex variably brown, VII varying from entirely brown to yellow with apex as brown as VIII; major setae hyaline, anal setae and tergal wing retaining setae dark; forewing often faintly shaded medially. With the structural characters indicated in the generic diagnosis; head with compound eyes longer dorsally than ventrally; maxillary stylets retracted to postocular setae, at least 0.3 of head width apart with distinct maxillary bridge (Fig. 2). Forewing with seven to nine duplicated cilia; with one or two capitate sub-basal setae. Anal setae longer than tube.

Measurements of paratype female (in microns). Body length 2600. Head, length 250; width 190; postocular setae 15. Pronotum, length 160; median width 300; major setae, aa 55; epim 70; pa 35. Forewing length 900; sub-basal setae 45, 50. Tergite IX setae S1 105; S2 115; S3 130. Tube length 200; anal setae 170. Antennal segments III – VIII length 70, 65, 65, 55, 55, 30.



FIGURES 2–4. *Klambothrips* species. 2, *K. myopori* male holotype; 3, *K. myopori* antenna; 4, *K. walsinghami*.

Macropterous male. Colour and structure generally similar to female, but size range greater; large male with massive fore tarsal tooth and enlarged femora, paired cheek setae prominent, also pronotum with anteroangular setae long, and fore coxae bearing stout setae; small male with minute fore tarsal tooth.

Measurements of holotype male, with smallest male paratype in parentheses. Body length 2150 (1650). Head, length 220 (180); width 170; postocular setae 15. Pronotum, length 160 (100); median width 325 (200); major setae, aa 50; epim 55; pa 40 (15). Forewing length 840; sub-basal setae 40, 45. Tergite IX setae S1 110; S2 105; S3 120. Tube length 175 (130); anal setae 150. Antennal segments III – VIII length 65, 55, 50, 48, 50, 25 (50, 45, 47, 45, 45, 25).

Larvae. Mainly white, but sometimes weakly pink, abdominal segments IX and X dark; pronotum brown; legs and antennal segments light brown, distal antennal segments darkest; abdominal setae long and capitate, each arising from a pigmented area; spiracle prominent on mesothorax and abdominal segments II and VIII.

Material studied. Holotype male, **USA, California**, Los Angeles, Sylmar, from distorted *Myoporum laetum* leaves, 13.ii.2006 (R. Orsburn) in Australian National Insect Collection, CSIRO, Canberra.

Paratypes: 6 females 4 males collected with holotype; 3 females 23 males, from *Myoporum* distorted leaves, California, San Diego County, 50 km north east of San Diego, 7.ix.2006 (Mark Hoddle 485); 4 females 3 males, from *Myoporum* distorted leaves, California, Orange County, Anaheim, 25.i.2006 (N. Nisson).

Specimens will be available in the major thrips collections at University of California Riverside, California Department of Food and Agriculture Sacramento, Washington, London, Frankfurt and Tokyo.

Comments. In all structural details, *K. myopori* is essentially similar to *K. walsinghami*, a species that is widespread in south-eastern Australia distorting leaves of *Myoporum insulare*. Samples from California and Australia exhibit great variation in body size, with several character states correlating with overall body size, including lengths of major setae and antennal segments. The only consistent morphological difference that has been found between samples from the two areas is in the position of the maxillary stylets, as indicated in the key above. This difference needs to be assessed in individuals that have not been macerated, because the natural position of the stylets commonly becomes distorted under chemical treatment. Despite this technical problem, no specimens have been seen from California with the stylets deeply retracted and closely placed as in Australian specimens. Molecular differences between two samples from California, including the type series of *K. myopori*, and samples of *K. walsinghami* from south-eastern Australia support the view that these two are separate species (Fig. 5). It seems possible that *K. myopori* is derived from New Zealand, despite not having been found in that country, and represents a scarcely distinguishable sibling to the common Australian species. If biological control agents were to be considered for use against this pest in California, then it will become important to compare molecular data from multiple samples in California and Australia, and an effective search made for the thrips in New Zealand. Both of these species have the mid and hind tarsi yellow, whereas *K. annulosus* and *K. oleariae* have these tarsi dark brown.

Klambothrips walsinghami **(Girault) comb. n.**

Liothrips walsinghami Girault, 1928: 2
Teuchothrips walsinghami (Girault); Mound, 1996a: 330

Girault was responsible for publishing, usually privately, 140 species-group names of thrips, but his species cannot be recognized from the descriptions, many are based on single, often damaged, specimens, and 72 are now placed as synonyms (Mound, 1996a). *Liothrips walsinghami* was based on one small damaged female, collected at Beaudesert, near Brisbane in south eastern Queensland. This specimen is particularly small and this, together with its damaged condition, makes it difficult to evaluate. A second specimen of the same species is one of the three syntypes of *Cryptothrips nigronympha* Girault, and these syntypes are reported as having been collected at Wallumbilla, near Roma, Queensland. Both of these localities are far beyond the northern distribution limits of *Myoporum insulare*, and no other specimens of the thrips have been seen from north of Mallacoota on the border between Victoria and New South Wales. These two specimens slide mounted by Girault cannot be distinguished from individuals of the common *Myoporum insulare* thrips of southern Australia; in particular, they have the maxillary stylets deeply retracted (Fig. 4). There is thus at present no alternative but to apply the Girault name to the common species, although the two Queensland specimens are presumably associated with some other species of *Myoporum*. In addition to these two Girault specimens, more than 60 slide-mounted specimens of both sexes have been studied from the following Aus-

tralian localities: **South Australia**, Adelaide (Semaphore and Wittunga); Aldinga; Victor Harbour; Kangaroo Island; Mt Gambier; Loxton; **Victoria**, Mallacoota.

As indicated above, the body size of this species is highly variable, with consequent variation in other character states. The body lengths of the largest and smallest male from a single gall at Semaphore, Adelaide, are 2450 microns and 1560 microns. Measurements in microns of the holotype female are as follows: Body length 1650. Head length 200. Pronotal major setae, aa 50; epim 65; pa 50. Tube length 150. Antennal segment III length 43.

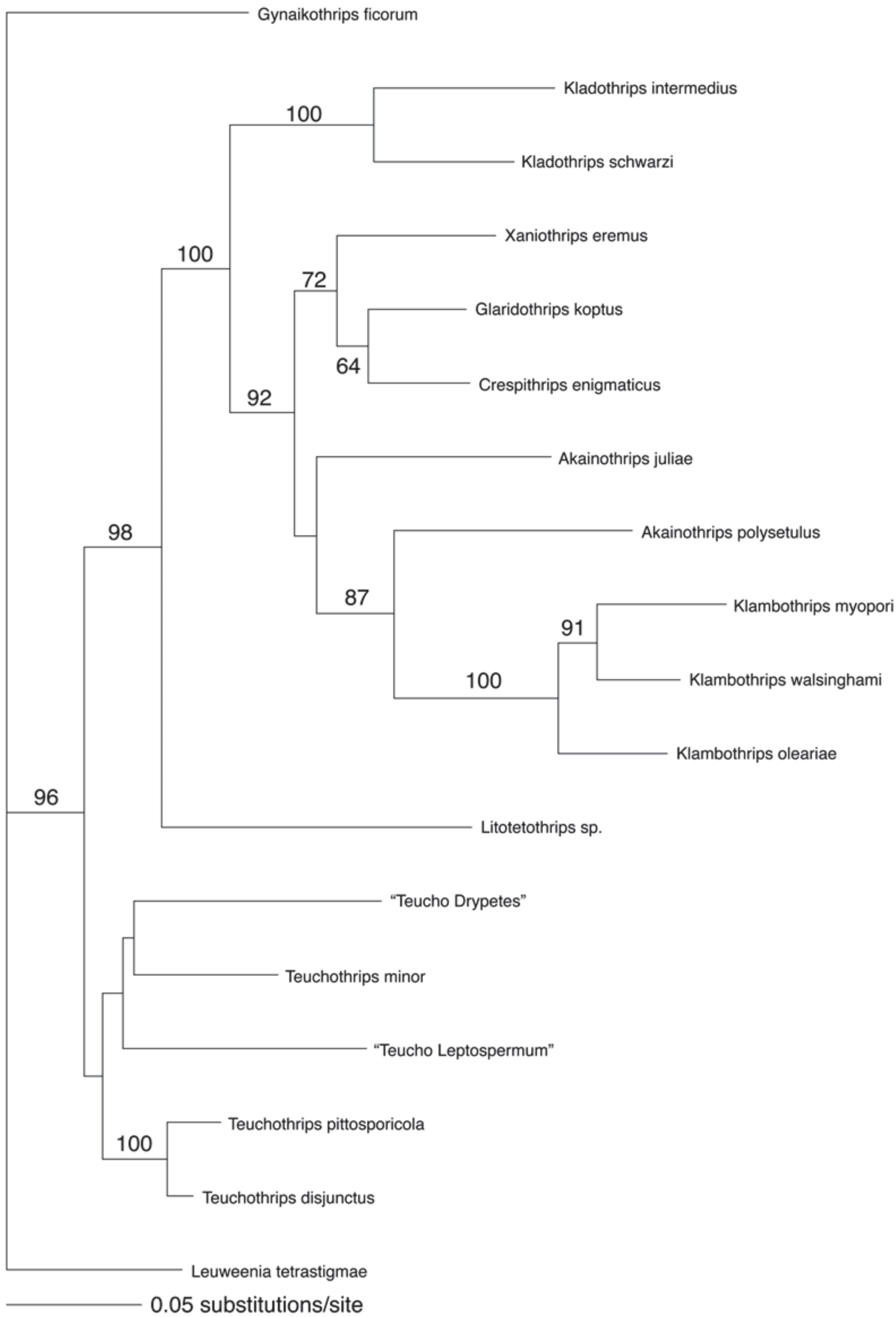


FIGURE 5. Relationships between some Australian Phlaeothripinae based on sequence data from the genes "wingless" and "CO1".

***Klambothrips annulosus* (Priesner) comb. n.**

Rhynchothrips annulosus Priesner, 1928: 645
Teuchothrips annulosus (Priesner); Mound 1996a: 328

This species was described from Warburton, north of Melbourne, on a series of specimens collected from galls on *Cassinia aculeata* (Asteraceae), but the only other Australian specimens known are two females collected in Tasmania, Lake St Claire, in March 2004. The species was recorded and re-described from New Zealand (Mound & Walker, 1986) on "*Cassinia vauvilliersei*", a plant species currently considered to be a member of the genus *Ozothamnus*. Females have very weak cheek setae, although these are stout in males. It differs from both *K. myopori* and *K. walsinghami* in having the mid and hind tarsi dark, not yellow, and it also has the setae on tergite IX pointed to bluntly rounded, not expanded at the apex. In the colour of the tarsi, *K. annulosus* is similar to the new species, *K. oleariae*, described below. However, *K. annulosus* is distinguished by the unusually elongate maxillary stylets, these being retracted to the eyes and almost touching medially, with exceptionally stout maxillary guides.

***Klambothrips oleariae* sp. n.**

Macropterous female. Body dark brown, tarsi brown; antennal segment III yellowish brown and darkest in apical half, IV – VI brown with pedicels paler; major setae hyaline but wing retaining setae dark; forewing clear. With the structural characters indicated in the generic diagnosis; head with compound eyes longer dorsally than ventrally; maxillary stylets retracted to postocular setae, about one fifth of head width apart medially with a short maxillary bridge. Pronotum with three or four pairs of long capitate setae; midlateral setae variable, usually no larger than discal setae; anteromarginals not distinguished from discal setae. Fore tarsus with no tooth. Forewing with about seven duplicated cilia, and two capitate sub-basal setae. Tergites IV – VI marginal setae S1 broadly rounded at apex; tergite IX setae S1 and S2 with broadly rounded capitate apex, S3 acute; anal setae shorter than tube.

Measurements of paratype female (in microns). Body length 2450. Head, length 270; width 185; postocular setae 15. Pronotum, length 140; median width 280; major setae, aa 65; epim 90; pa 85. Forewing length 850; sub-basal setae 45, 55. Tergite IX setae S1 135; S2 125; S3 135. Tube length 200; anal setae 170. Antennal segments III – VIII length 55, 65, 65, 55, 65, 35.

Macropterous male. Colour and structure similar to female; large male with broadly based fore tarsal tooth and enlarged femora.

Measurements of holotype male. Body length 2150. Head, length 240; width 180; postocular setae 15. Pronotum, length 175; median width 280; major setae, aa 70; epim 80; pa 65. Forewing length 850; sub-basal setae 45, 55. Tergite IX setae S1 125; S2 75; S3 135. Tube length 175; anal setae 170. Antennal segments III – VIII length 55, 60, 60, 55, 60, 35.

Larvae. Mainly white, but sometimes weakly pink; antennae, head, pronotum and abdominal segments IX and X almost black; abdominal setae long and capitate, each arising from a pigmented area; spiracle dark and prominent on mesothorax and abdominal segments II and VIII.

Material studied. Holotype male, **Australian Capital Territory**, Tidbinbilla, in curled leaf of *Olearia lirata*, 15.xii.1995 (LAM 2909) in Australian National Insect Collection, CSIRO, Canberra. Paratypes: 1 male, 13 females collected with holotype; same host and locality, 7 females, 1.iii.1996; **ACT**, Australian National Botanic Gardens, 3 females from *O.* ?*lirata* curled leaves, 29.i.1996. **Victoria**, Melbourne Botanic Gardens, 6 males, 7 females in curled leaf of *Olearia lirata*, 28.iv.2002 (P. Symes).

Comments. Although distorted leaves associated with species of the *Teuchothrips* complex have been examined from many different plant species in eastern and northern Australia, only *K. annulosus* and *K. ole-*

ariae are known from Asteraceae. These two species are distinguished in the key above on character states of the maxillary stylets and the setae on the abdomen. Moreover, in *K. oleariae* the pronotal midlateral setae are variable, sometimes being longer than the discal setae and almost capitate.

Acknowledgements

Our Californian colleagues, Mark Hoddle of the University of California at Riverside, and Gillian Watson of the Dept of Food and Agriculture Plant Pest Diagnostics Laboratory at Sacramento, kindly provided information and specimens. The photograph of thrips damage to *Myoporum laetum* was kindly provided by John Kabashima, University of California. Cooperative Extension, Orange County. The web search engine "google.com" provided access to much information about *Myoporum* in California. We are grateful to Bob Chinnock of the South Australian Herbarium for advice on species of the genus *Myoporum* and for help in collecting thrips samples. Loans of specimens from the Girault collection at the Queensland Museum were kindly arranged by Geoff Thompson and Susan Wright.

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